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ORIGINAL ARTICLES.

SPLENIC ANEMIA, SPLENECTOMY, AND RECOVERY.[1]

WITH STUDIES OF THE BLOOD COVERING A PERIOD OF SEVEN YEARS.

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THE fact that the patient, whose case I report herewith, has been subjected to a careful study for a long period of time, four years before and three years following the operation of splenectomy, makes the case worthy of record. During this whole period of seven years a large number of blood examinations have been made most accurately for me by one man, Dr. W. Estell Lee, chief resident physician of the Pennsylvania Hospital, Philadelphia, to whom I wish to give credit. The question of the personal equation, which often interferes with the accuracy of work, is thus reduced to a minimum.

J. M., a male, was seventeen years of age at the time of operation in 1904. He had been under my professional care since infancy, but came under particular observation in 1900 at which time the first enlargement of the spleen was detected. Shortly after his birth, which was a most difficult one, his mother was found to be suffering from nephritis, which had affected other members of her family. Some years later, after another pregnancy, she died uremic. The patient's father is of a very nervous temperament, but otherwise healthy. At the age of two years, the patient was enormously fat, but seemed to be perfectly healthy. His family was living near the

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[1] Read at a meeting of the Association of American Physicians, Washington, D. C., May 12 and 13, 1908.

Schuylkill River in a somewhat malarial neighborhood, and the child had several attacks of indisposition with fever, during which the probability of malaria was considered, but at no time could the plasmodium be discovered in his blood. In 1900, when thirteen years of age, he was found wanting in tone and quite pallid, with a decided bronchitis. Examination of his spleen showed it to be slightly enlarged. Quinine, iron, and arsenic were administered with apparent benefit.

In March, 1901, an examination of his blood showed 5,260,000 red cells, 5460 leukocytes, and 74 per cent. of hemoglobin. No plasmodia were discovered; there was marked poikilocytosis. The organs of the chest and abdomen appeared normal. The boy was a very large eater, with constipation alternating with diarrhœa. His abdomen was large, and had always been so, and he had occasional attacks of indigestion. At this time, curiously, no enlargement of the spleen could be detected, although palpation and percussion caused pain.

In May, 1902, an examination of his blood showed red blood cells, 4,688,000; leukocytes, 8000, and hemoglobin, 69 per cent. No malarial organisms were found, and the poikilocytosis, though slight, persisted. In October of this year, after a summer holiday at Digby, Nova Scotia, his spleen was found to be enormously enlarged, extending two and one-half inches below the lower border of the ribs. His blood showed red cells, 5,400,000; leukocytes, 4800, and hemoglobin 72 per cent. He looked quite pale, was languid and disinclined to play, and his bowels were capricious. He was growing considerably taller and heavier, but not keeping up his strength. His weight was ninety-six and three-quarter pounds. By the spring of 1903 he had made a decided improvement. His red cells were 5,420,000, his leukocytes 6200, and his hemoglobin 84 per cent; all poikilocytosis had disappeared. His color was better and the spleen appeared to have diminished in size and was absolutely painless to percussion and palpation.

In the autumn of 1903 he returned from Europe looking well. While there, several physicians were consulted, but no light was shed upon the diagnosis or treatment. He now weighed 111 pounds, which rapidly, on his return, increased to 119¼. The splenic area remained the same. Notwithstanding his improved appearance, his red cells had fallen to 4,340,000, and his hemoglobin to 69 per cent.

By the spring of 1904 his appearance had further improved, his red cells had risen to 5,020,000, and his hemoglobin to 90 per cent. He still was given to overeating, ate too fast, and as a consequence suffered from occasional indigestion.

On the night of May 22, 1904, after an unusually hearty meal, he felt nauseated and vomited a little blood, but there was no melena or diarrhœa. In the morning he felt sufficiently well to go to school.

On the morning of the 25th he awoke feeling oppressed, but not nauseated, and had an explosive attack of vomiting of blood; the amount vomited was very large, one of the family remarking that the bathroom looked like a "shambles." During the day this vomiting of blood was twice repeated, and later in the day he had a large tarry evacuation.

When seen in the evening he was ghastly pale and had very violent pain to the right of the ensiform cartilage, about over the notch of the liver. His abdomen was distended, but there was no rigidity of the recti muscles. Palpation over the region of the gall-bladder elicited decided pain. The stomach was greatly distended, the greater curvature extending nearly to the horizontal line of the navel.

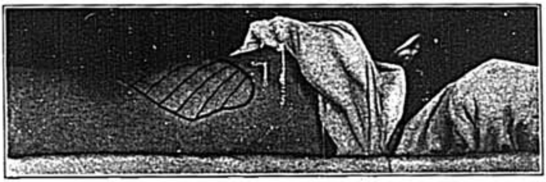

FIG. 1

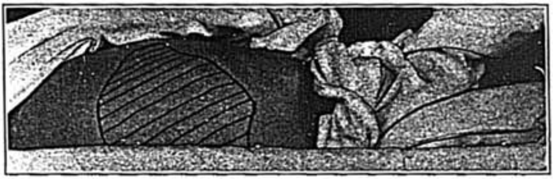

FIG. 2

FIGS. 1 and 2.—Area of splenic dulness as marked on the patient shortly before operation.

His temperature was 102° F. During the night he had two large tarry evacuations. He was at once removed to the Pennsylvania Hospital, where he had, during the next night, several bloody evacuations. His hemoglobin was now only 30 per cent. and his red cells 2,200,000. By the next morning his temperature had returned to normal and his stomach had returned to its normal position. The area of the splenic dulness had decreased decidedly (Figs. 1, 2, and 3). On the 26th the hemoglobin had fallen to 25 per cent., and brighter blood began to be passed with the stools.

On account of the previous symptoms pointing to gastric indigestion and the continuance of the bleeding from the bowel, the question of gastric or duodenal ulcer was considered. A consultation was held with Drs. LeConte and Harte, and the operation of posterior gastro-enterostomy was decided upon and performed by Dr. Harte. During the operation no sign of ulcer was detected either in the stomach or bowel. The patient rallied slowly from the operation, during which two quarts of normal salt were used by transfusion.

During the next two days he had fourteen bloody evacuations, losing in all thirty-six ounces of blood, but by the 29th practically all bleeding had ceased. On May 31 and June 1 his hemoglobin percentage was only 18.

He made an uneventful recovery from the gastro-enterostomy, all stitches being removed by the end of the second week, at which time his spleen was found to extend three inches below the margin of the ribs in the midaxillary line.

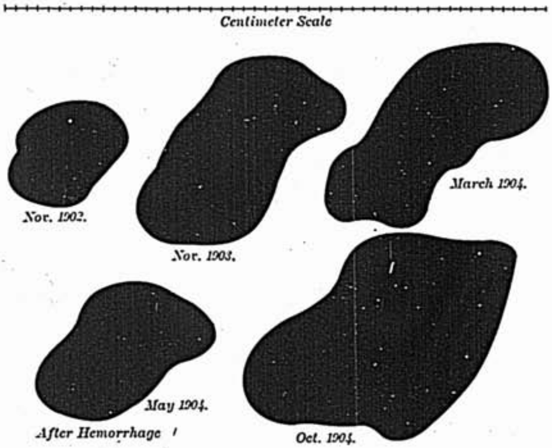

FIG. 3.—Variations in the size of spleen as shown by percussion and palpation.

Shortly after this his liver enlarged decidedly, his abdomen became distended, and considerable ascites appeared. His evacuations were now frequent and liquid, but not bloody. By July 12 he was considered to have improved sufficiently to be sent to Atlantic City to recuperate. Occasional bloody streaks appeared in his evacuations until the middle of August. By September he was feeling well, had a good appetite and no trouble with digestion, and was able to walk without fatigue. His hemoglobin was 52 per cent., his red cells numbered 3,400,000 and showed slight poikilocytosis, and his leukocytes were 4200. By October, 1904, his spleen had increased much in size (Fig. 3). He had gained four pounds in weight and his blood had improved slightly, showing a hemoglobin percentage of 54, and a red cell count of 4,200,000. He was having, on an average, six bowel movements, slightly streaked with blood, every day, but no true hemorrhage. The large spleen appeared to be freely movable, and examination of the other organs was negative.

He was again admitted into the Pennsylvania Hospital, and the operation of splenectomy was decided upon. The patient felt no inconvenience at any time from the previous operation of gastro-enterostomy, although in the light of the further study of the case and the diagnosis of chronic splenic anemia, which it was feared was in the terminal stage, or Banti's disease, we regretted having performed it. It is true the hemorrhage lessened after the operation, and the thought has since arisen whether possibly the adhesions which must have formed had not really had the effect of an accidental Talma's operation, forming an anastomosis between the internal veins and those of the abdominal wall, thus relieving the venous congestion and really improving his condition. This result occurred after gastro-enterostomy in a case of profuse gastric hemorrhage seen by me in consultation with Dr. Wm. J. Taylor, of Philadelphia, and later reported by him.[2] Could it be possible that the lessened motions of the stomach, consequent upon the operation, had been effective in diminishing the venous oozing? for after the fourth day very little blood was passed by the bowel.

The operation of splenectomy was performed by Dr. Harte on October 14, 1904. The spleen was found tightly adherent. Silk ligatures were used for the many adhesions and for the splenic vessels. Gauze drainage was used.

This case, although not heretofore reported by Dr. Harte or myself, has been listed as a successful case of splenectomy by Dr. G. E. Armstrong,[3] of Montreal, Canada, and also by Dr. Gaston Torrance,[4] of Birmingham, Alabama. This fact is referred to here for accuracy, in order that it may be seen that these two reports and mine all refer to one and the same case.

The patient reacted fairly comfortably, but in six days a slight pleural effusion, with impairment of expansion of the posterior portions of the left lung, was discovered. A week later pericarditis supervened, but from this and the pleural effusion, and from a secondary abscess in the wound, which was opened on September 9, and from which three ounces of pus was discharged, he recovered perfectly. A sinus remained for weeks subsequently, and all the silk sutures were discharged one by one until 23 were collected, when the sinus closed entirely (the end of October, 1905), and has since given no trouble. At this time he looked well, weighed 126 pounds (clothed), had a good appetite, and never felt better in his life. He was able to take exercise freely without any sense of strain.

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[2] Trans. Coll. of Phys., Philadelphia, 1906.

[3] Brit. Med. Jour., November 10, 1906, Case No. 25.

[4] Charlotte (Alabama) Medical Journal, 1907, Case XXXI.

By the next year he again had some sense of indigestion, which was undoubtedly due to indiscretions in diet. At no time has there been any pigmentation of the skin or enlargement of the thyroid or of the lymphatic glands. The patient now, in 1908, seems to be in perfect health, although, as might be expected, indiscretion in diet causes some distress and diarrhœa. He weighs over 130 pounds, he is very active, and takes exercise, swimming, etc., with perfect comfort. He has had no further hemorrhage.

As a proof of his occasional indiscretion in diet, he has been known, since the operation, to eat, on a wager, twelve ears of corn at one sitting, and not suffer seriously in consequence, except for a diarrhœa which yielded to appropriate treatment. An inveterate acne vulgaris appeared shortly after the operation and still remains, notwithtanding all efforts to relieve it.

The blood charts (Figs. 4, 5, and 6) show: (1) The percentage of hemoglobin, and the red blood cells per cubic millimeter from March 16, 1901, to February 20, 1908. (2) The total leukocyte count for the same period; and the polymorphonuclear leukocytes, the large mononuclear leukocytes, and the lymphocytes, all per cubic millimeter, for two periods: May 5, 1904, to July 22, 1904, and from October 14, 1904, to February 20, 1908. (3) The eosinophiles and basophiles per cubic millimeter also for two periods: May 28, 1904, to July 22, 1904 (the gastro-enterostomy period), and from October 14, 1904 (the splenectomy period), to February 20, 1908.

The continuous tracings on the charts represent the period when but a day or so elapsed between the examinations, while the isolated records represent the examinations which have been made at considerably longer intervals. To join both of these records with a continuous tracing would give an erroneous impression as to time relationship. The total number of the elements of the blood have been calculated for each cubic millimeter rather than recording the percentages.

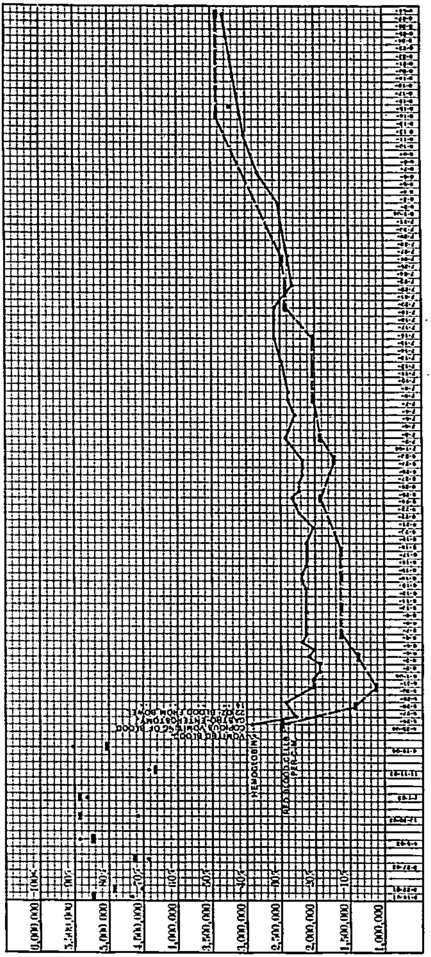
In examining Fig. 4, it is seen how profuse the hemorrhage was, as the hemoglobin fell from 90 per cent., where it was but a short time before the loss of blood, to 18 per cent., which low point was reached a few days subsequently; this and the subsequent rise to health is represented by the continuous line and by the isolated records. The broken line shows the red blood cells per cubic millimeter.

In Fig. 5 two periods of leukocytosis are seen, the first being a posthemorrhagic leukocytosis in May, 1904, and the second period corresponding with the time of removal of the spleen. A rapid rise to over 10,000 per cubic millimeter occurred in three days, this rise being evidently largely due to the inflammatory complications which followed the operation: pleural effusion, pericarditis, and the abscess in the wound; this continued until 24,000 leukocytes per cubic millimeter was reached, after which the count rapidly fell, so that within one month after the operation it averaged 10,000 per cubic millimeter; this average has remained until the present time, considerably higher than it was before the violent vomiting of blood at which time the count averaged about 6000 per cubic millimeter, and very much higher than the low quiescent period, between the two operations, when it averaged 4000 per cubic millimeter. As all apparent cause of leukocytosis is absent, unless it might be the pronounced acne, it is difficult to disassociate it from the removal of the spleen and the consequent compensatory reaction of the bone marrow. Ehrlich and others distinctly assert that leukocytosis is purely a function of the bone marrow. The polymorphonuclear count follows very closely in character the tracing of the total leukocytes, and shows a marked increase over normal immediately after the splenectomy period and during the subsequent inflammatory complications, but it soon falls to normal. The lymphocytes show a moderate irregular rise at two periods: at two weeks and at one and a half years after the removal of the spleen, and even here the normal count of from 20 to 25 per cent. of the total leukocytes was barely reached.

Fig. 6 is most interesting and shows the marked eosinophilia which occurred immediately after the splenectomy. The large number of eosinophile records which were made previous to the operation also renders this chart valuable, as in most cases of splenectomy but few records have been taken previous to the operation. This absence of pre-operative eosinophilia rather points to the fact that the functions of the spleen were not entirely abrogated by disease, else according to Kurloff's law of the secondary reaction of the bone marrow, they would have been increased.

During June and July the eosinophile count varied from 10 to 100 per cubic millimeter, with an average of 50, during which time the total leukocyte count fell from 16,600 to 1200 per cubic millimeter. There is but little change in the eosinophile count for this period, but if the total leukocyte count is examined it will be seen that a very great change in the percentage of the former occurs.

The method of tabulating the actual count of the blood elements per cubic millimeter is preferable to registering the percentage, as the latter, as has just been stated, may change decidedly without correspondingly altering the actual count. The high eosinophile record of 1800, on October 31, 1904, out of a total leukocyte count of 16,000 is only equivalent to 11.2 per cent., while the much lower records of 630 eosinophiles, on November 3, 1904, out of a to al leukocyte


6,000,000
5,500,000
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70%
60%
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10%
HEMOGLOBIN
RED BLOOD CELLS PER C.M.
VOMITED BLOOD
COPIOUS VOMITING OF BLOOD
GASTRO-ENTEROSTOMY
22 OZ. BLOOD FROM BOWEL

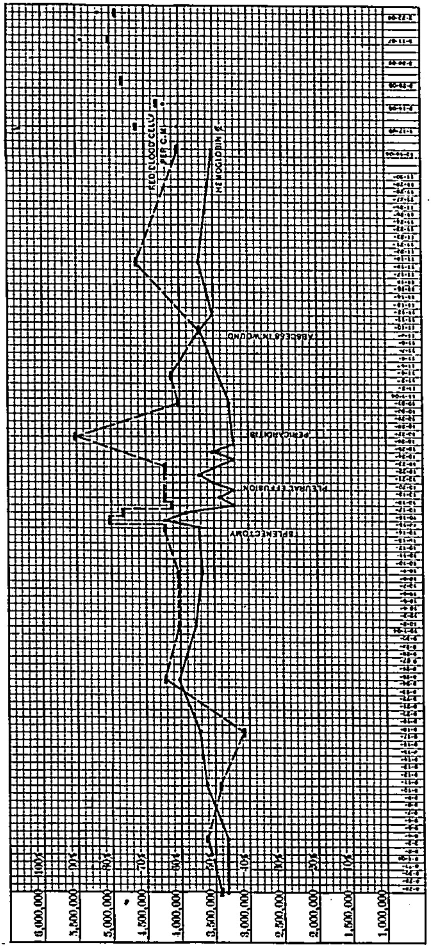
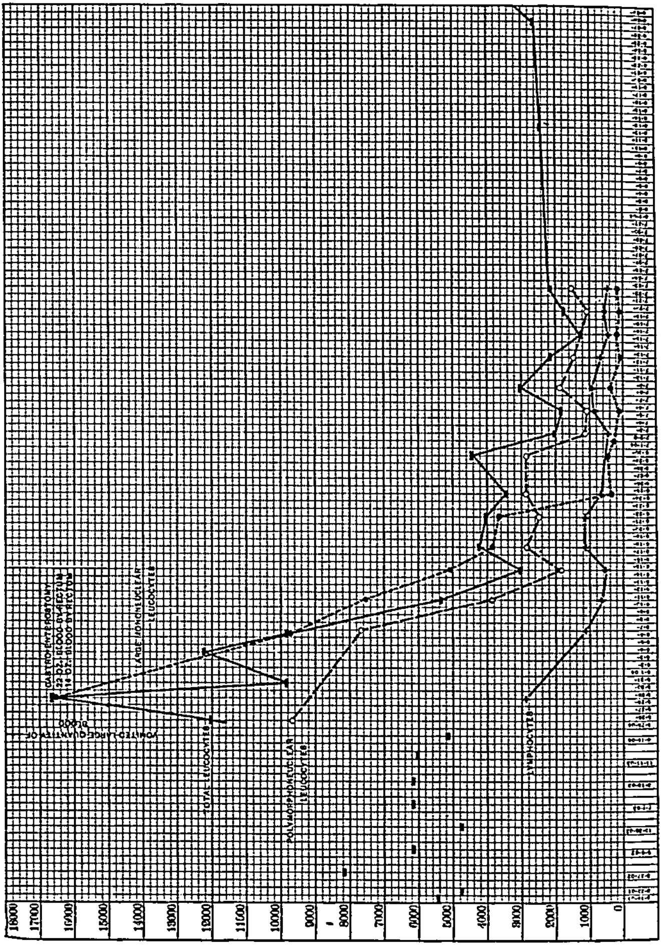


FIG. 4.—Percentage of hemoglobin and the red-blood cells per cubic millimeter, from March 16, 1906, to February 20, 1908.


GASTROENTEROSTOMY
22 OZ. BLOOD BY RECTUM
14 OZ. BLOOD BY RECTUM
VOMITED LARGE QUANTITY OF BLOOD
LARGE MONONUCLEAR LEUCOCYTES
TOTAL LEUCOCYTES
POLYMORPHONUCLEAR LEUCOCYTES
LYMPHOCYTES
18000
17000
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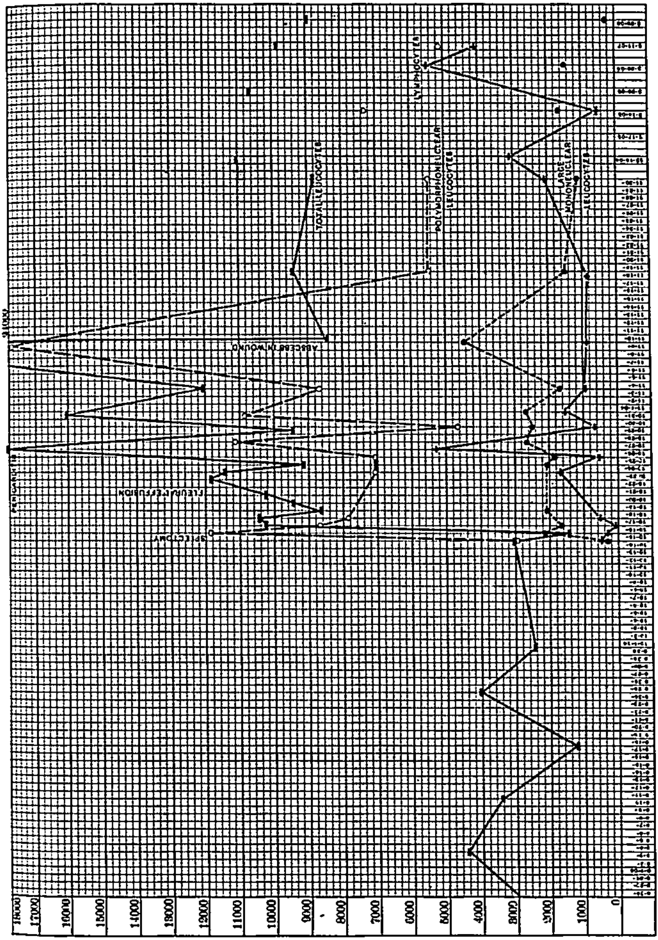

FIG. 5.—Total leukocytes, polymorphonuclear leukocytes, large mononuclear leukocytes, and lymphocytes per cubic millimeter, at the dates indicated on the margin.

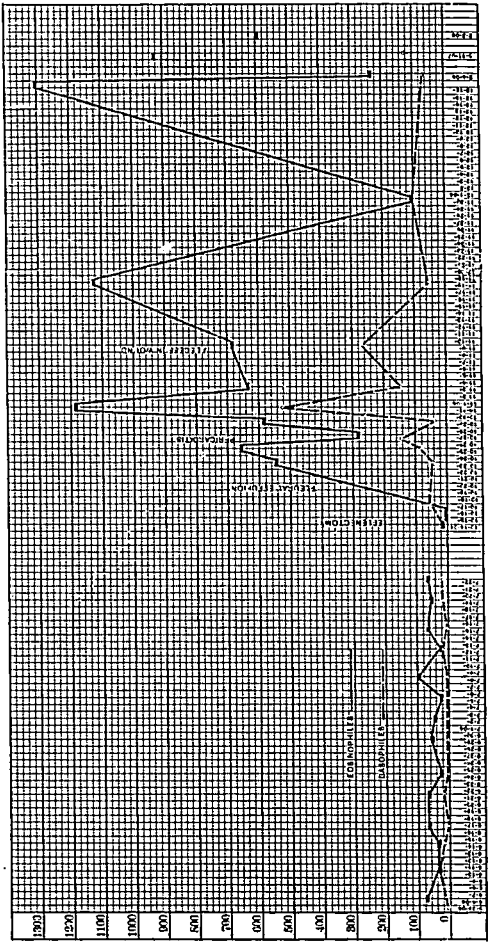

FIG. 6.—Eosinophiles and basophiles per cubic millimeter, at the dates indicated on the margin.

count of 13,000, and of 670 on November 8, 1904, out of a total leukocyte count of 24,000, represents 4.8 per cent. and 2.8 per cent., respectively, which would lead one to an erroneous opinion as to their actual numbers. Two depressions in the tracing correspond to the time of the pericarditis and the abscess formation. The two very low points, 100 and 203, respectively, per cubic millimeter, do not correspond with any recognizable changes in the patient's physical condition, nor with anything unusual in the tracings on the other charts.

The sudden postoperative eosinophilia does not agree with the statements of Kurloff, or of Hartmann and Vaquez, who state that eosinophilia is a late manifestation after this operation, and is due, as previously stated, to the secondary reaction of the bone marrow, the so-called compensatory eosinophilia.

In the case of splenectomy reported by Stengel[5] 7.8 per cent. of eosinophiles were found on the day before the operation, but as he neither mentions the number per cubic millimeter nor the total number of leukocytes, the record cannot be compared with my tracing. It is, however, a positive eosinophilia antedating the operation. An immediate drop to 0.2 per cent. occurred, and then a rise on the fourth day to 10.5 per cent., or a total of 1335 per cubic millimeter; but in this case, as in mine, the record was probably modified by a serious postoperative complication; in Stengel's case, pneumonia.

Kurloff, in his studies on splenectomized guinea-pigs, quoted by Ehrlich, reaches the conclusion that a lymphocytosis "occurs so constantly in the course of the first year after the operation as to constitute a characteristic of the absence of the spleen," and that this lymphocytosis "in the majority of cases retrogrades during the course of the first year even to a condition in which a less number of lymphocytes than normal is produced." This condition does not obtain in the present case, as may be seen in Chart II; neither did it occur in Stengel's case.

Hartmann and Vaquez, quoted by Ehrlich, conclude that splenectomy causes: (1) A slight postoperative increase of the red blood corpuscles, and a genuine, though very transitory, acute hyperleukocytosis. (2) A primary decrease of hemoglobin, which gradually rises again to normal. (3) After four to eight weeks a lymphocytosis of varying duration. (4) A moderate eosinophilia occurring late, after many months.

The correct understanding of the blood changes after splenectomy in man can only be attained when splenectomy is performed for injury to that organ in a previously healthy individual and when the wound heals without any complications supervening, a condition probably impossible to attain. This study, however, enhances our knowledge of the blood and the changes occurring in it after splenectomy, and justifies the report.

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[5] Trans. Assoc. Amer. Physicians, 1904.

The size of the spleen may be seen in the photographs taken shortly before operation, the splenic area being traced on the patient's body (Figs. 1, 2, and 3), and in the photograph of the removed spleen (Fig. 7). Naturally the splenic area, as mapped out by palpation and percussion while the organ was still in the patient and full of blood, would make the spleen appear larger than is seen after removal. Fig. 3 shows the variations in the apparent size of the spleen as thus mapped out, as well as the marked effect of the severe hemorrhage in May, 1904.

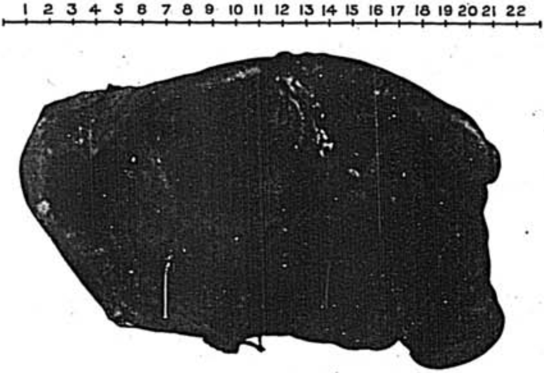

FIG. 7.—Photograph of the spleen immediately after removal. (The measurements are in centimeters.)

The unusual number of ligatures that were required, 23 in all, prove how great was the dilatation of the splenic veins. The application of these ligatures produced no appreciable effect upon the venous circulation, as might have been imagined, but all blood at once ceased to appear in the evacuations, which tends to prove that the spleen is not merely passive in this disease. The enlargement of the liver, so frequently seen, existed for a short time only, about two weeks after the gastro-enterostomy, was accompanied by ascites, and then entirely subsided, and was absent at the operation for splenectomy.

Dr. Warfield T. Longcope, director of the Ayer Clinical Laboratory of the Pennsylvania Hospital, reports as follows concerning the examination of the spleen:

"The spleen is of very great size. It weighs 790 grams and measures 20 x 13 x 7 cm. It is quite firm in consistency and has a rubbery or leathery feel. It is quite irregular, and there are three fairly deep notches on the upper margin. A great many adhesions cover the capsule, and on the superior surface two depressed white thickened areas are seen. The largest measures 5 cm. and is situated in the posterior portion. The other measures 4 cm. in diameter and is situated in the inferior anterior portion. The color is rather a pale red. On section the cut surface is smooth, slippery, and rather dry. The pulp is firm and of a homogeneous light red color. The Malpighian bodies are very small or invisible. Trabeculæ are very white, prominent, and are much increased in number and size. The vessels at the hilum are clear.

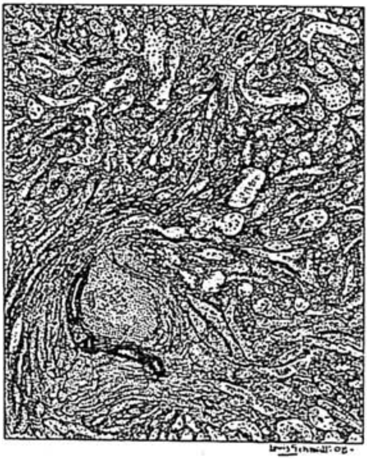

Fig. 8.—Microscopic appearances of the spleen.

"Smears are made from the freshly cut surface of the spleen and stained in Wright's stain. Most of the cells are red blood corpuscles. A few normoblasts are seen. The white cells are principally small lymphocytes. Moderate numbers of large lymphocytes are seen and several much larger cells which are apparently endothelioid cells. Fair numbers of polymorphonuclear leukocytes are met with. Quite a large proportion have eosinophilic granules. No phagocytic cells or red-blood-corpuscle-carrying cells. No cellular inclusions. No pigment.

"Sections are made through various portions of the organ. They all have about the same appearance (Fig. 8). The capsule is very much thickened and is composed chiefly of hyaline connective tissue. To it are attached irregular projections of fat and connective tissue. Throughout the section there is a very extensive increase in connective tissue, both in the trabeculæ and in the pulp. The organ contains comparatively little blood. The walls of the venous spaces are greatly thickened by a growth of rather cellular connective tissue. In Mallory's connective tissue stain the walls are seen to be made up of a reticulated fibrous tissue. The venous spaces are small. Besides red blood cells they contain a few polymorphonuclear leukocytes, many small round cells, and an occasional large endothelioid cell. Very rarely a red-blood-corpuscle-carrying cell is seen. The cells in the walls of the sinuses are principally connective tissue cells. No uninuclear or multinuclear giant cells are seen. Very few eosinophiles are seen in sections.

"The Malpighian bodies are quite scarce. Many of them are very small. The reticulum beneath the cells is thickened and the follicle is overgrown with connective tissue. Others appear unusually large and show compensatory hypertrophy. They are quite regular. The middle of the follicle is composed of a large germinal centre filled with large irregular pale cells of epithelioid type. The margin is quite regular and is bordered by a narrow dense zone of small lymphocytes. Beyond this is a wider, paler zone of cells, chiefly small lymphocytes, fairly well separated and mixed with a few large lymphocytes and epithelioid cells. The boundary zone is regular and definite. The reticulum is not thickened except in a few instances about the outer border. No pigment is seen. There are a few small areas of blood mixed with fibrin. The connective tissue about the vessels is much increased, but the intima of the blood-vessels is delicate. Taken as a whole, the spleen shows an extreme grade of thickening of the walls of the venous spaces with a diffuse increase in rather cellular connective tissue. Many of the Malpighian bodies are atrophied, though a few are exceedingly large with active proliferating germinal centres.

"Diagnosis: Chronic perisplenitis and interstitial splenitis."

CLINICAL NOTES ON LARYNGEAL TUBERCULOSIS.[1]

By Beverley Robinson, M.D.,

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It seems to me it may be of interest to record some personal observations and experience about tuberculosis as it appears in the

[1] Read at a meeting of the New York Academy of Medicine, January 16, 1908.